

Wherefore, what is claimed is:

1. A computer-implemented process for combining a precision
estimate of a database entry's coordinate value with the coordinate value into a
5 single index, comprising the process actions of:
 inputting one or more location entities; and
 computing a grid index series wherein each location entity is represented
as a series of grids that incorporate the location of each location entity.
- 10 2. The computer-implemented process of Claim 1 further comprising
the process action of outputting said grid index series to a database.
3. The computer-implemented process of Claim 1 wherein a location
entity is a point.
- 15 4. The computer-implemented process of Claim 1 wherein a location
entity is an area.
5. The computer-implemented process of Claim 4 wherein said area
20 is defined by a center latitude and longitude and a width and a height, each
measured from the center latitude and longitude and along lines of latitude and
longitude.

6. The computer-implemented process of Claim 1 wherein
equirectangular projection is used to input latitude and longitude values of said
one or more location entities as x-y pairs on a Euclidean coordinate system.

5 7. The computer-implemented process of Claim 1 wherein the
process action of computing a grid index series comprises:
gridding the globe at a prescribed number of resolutions;
indexing each grid in raster scan order; and
mapping the latitude and longitude coordinates of each location entity to
10 the index.

8. The computer-implemented process of Claim 7 wherein the
prescribed number of resolutions is 20.

15 9. The computer-implemented process of Claim 7 wherein the
process action of indexing each grid in raster scan order comprises:
for each grid,
determining the longitudinal span, D , in degrees that three
standard deviations corresponds to, where a standard deviation σ is the
20 measurement error of a given latitude, longitude coordinate; and
determining the degree-scale of precision, R , to be the discrete
unit of resolution just larger than D .

10. The computer-implemented process of Claim 9 wherein the longitudinal span in degrees that 3σ meters corresponds to is $d = [180(3\sigma) \cos(\text{latitude})]/k\pi$ is determined, where k is the circumference of the earth in meters.

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11. The computer-implemented process of Claim 9 wherein the process action of determining the degree-scale of precision, R , to be the discrete unit of resolution just larger than D comprises setting $r = \lceil -\log_2 d/20 \rceil$.

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12. The computer-implemented process of Claim 7 wherein the globe is gridded with overlapping grids at each scale in order to increase accuracy.

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13. The computer-implemented process of Claim 12 wherein coordinates of location entities are mapped to the square whose center is closest.

14. The computer-implemented process of Claim 1 wherein the location entity is geographic location data.

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15. The computer-implemented process of Claim 1 wherein the location entity is described in terms of latitude and longitude.

16. The computer-implemented process of Claim 15 wherein the latitude and longitude values are taken as straight x-y pairs on a Euclidean coordinate system.

5 17. The computer-implemented process of Claim 1 wherein the location entity is described in terms of latitude, longitude and altitude.

18. The computer-implemented process of Claim 17 wherein the latitude, longitude and altitude values are taken as (x,y,z) pairs on a Euclidean
10 coordinate system.

19. The computer-implemented process of Claim 7 wherein the location entity's coordinates in latitude (lat) and longitude (long) is mapped to the index by $l = \left(\frac{360}{r}\right) \left\lfloor \frac{lat + 90}{r} \right\rfloor + \left\lfloor \frac{long + 180}{r} \right\rfloor$ where r is the degree-scale of precision, and l
15 maps the coordinates to the location entity

20. The computer-implemented process of Claim 19 wherein to recover the latitude and longitude values, the latitude (lat) and longitude (long) is calculated as:

$$lat = \frac{lr^2}{360} - 90 + \frac{r}{2},$$
$$long = l\% \frac{r^2}{360} - 180 + \frac{r}{2},$$

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where r is the degree-scale of precision, l maps the coordinates to the location entity, and $\%$ is the modulus operator.

5 21. The computer-implemented process of Claim 2 wherein the database comprises a location entity identifier and a scale index for one or more scales each corresponding to a different grid.

10 22. The computer-implemented process of Claim 2 wherein a query of the database comprises the following process actions:
 querying which location entities are in a given grid cell at a given grid scale;

 searching in the data of the given grid scale for the values of the given grid cell; and

 returning said values of the given grid cell at the given grid scale.

15 23. A system for indexing a multi-dimensional space with a one dimensional value, the system comprising:

 a general purpose computing device; and

20 a computer program comprising program modules executable by the computing device, wherein the computing device is directed by the program modules of the computer program to,

 construct a hierarchical grid index from a number of grid indices overlaid on the same space with grid units of different sizes wherein the size of each grid is related to the precision of the coordinate values of a database entry.

24. The system of Claim 23 wherein the database entry is a geographic location.

5 25. The system of Claim 23 wherein the database entry is a time.

26. A computer-readable medium having computer-executable instructions for combining a precision estimate of a database entry's coordinate value with the coordinate value into a single index, said computer executable instructions comprising:

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inputting one or more location entities; and

computing a grid index series wherein each location entity is represented as a series of grids that incorporate the location of each location entity.

15 27. The computer-readable medium of Claim 26 wherein the instruction computing a grid index series uses an equirectangular projection.

28. The computer-readable medium of Claim 26 wherein the series of grids grid the globe at twenty different resolutions, with "square" units whose sides correspond to $20 \times (\frac{1}{2})^r$ degrees, for $0 \leq r < 20$.

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29. The computer-readable medium of Claim 26 wherein the series of grids is a hierarchical series of equilateral polygons embedded within a Platonic solid.

5 30. The computer-readable medium of Claim 26 wherein the series of grids is a hierarchical series of polygons that grids the globe.